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ABSTRACT

The study investigated maintenance of responding by four severely to moderately mentally retarded persons (12 to 16 years old) in a community living center who were taught methods of exiting the house in fire emergency situations. Training included instructions, modeling, behavioral rehearsal, social and tangible external reinforcement, and self reinforcement. To facilitate maintenance, all Ss received isolated, followed by simultaneous, presentation of situations and those Ss who met certain criteria received reinforcement fading and alteration from external to self reinforcement. To increase likelihood of generalization to an actual fire, Ss were taught in their own home and were presented with simulated cues. Generalization to a second room was trained to Ss meeting criteria. Results indicated that the procedure was effective in both training and maintaining emergency exiting skills in the simulated setting. Generalization probe data indicated the need to either program generalization or train children in their own rooms. (Author)

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Programming Maintenance as a Major Component of a Community-Centered Preventive Effort: Escape from Fire

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Abstract

The present study investigated maintenance of responding by severely-to-moderately mentally retarded subjects following behavioral training of socially validated methods of exiting from a burning house. Four subjects in a community living arrangement were taught methods of exiting the house in fire emergency situations via a multiple baseline design across subjects. Training included instructions, modeling, behavioral rehearsal, social and tangible external reinforcement and self-reinforcement. To facilitate maintenance, all children received (a) isolated followed by simultaneous presentation of situations and those children who met certain criteria received (b) fading of reinforcement and (c) alteration from external to self-reinforcement. To increase the likelihood of generalization to an actual fire, children were taught in their own home and were presented with simulated cues. Generalization to a second room, a secondary focus, was trained to those children who met designated criteria via fading of reinforcement, self-reinforcement and training in a third room. The results indicated that the procedure was effective in both training and maintaining emergency exiting skills in the simulated setting. Generalization probe data indicated the need to either program generalization or train children in their own rooms. The results were socially validated through presentation of a questionnaire to firefighters.

Although the effectiveness of behavioral programs in training adaptive skills seems well documented (e.g., Azrin & Foxx, 1971; Berkowitz, Sherry, & Davis, 1971; Bucher & Reaume, 1979; Neef, Iwata, & Page, 1978; Trace, Cuvo, & Criswell, 1977; Yeaton & Bailey, 1978), there is a growing conviction concerning the need for more evidence with reference to the effectiveness of current procedures in establishing maintenance and generalization of responding. In addition, increased emphasis on community relevance (through inclusion of an even greater variety of adaptive skills, more types of subject populations and social validation of improvement) may enhance the usefulness of this area of instruction.

With reference to the issue of maintenance and generalization, certain variables seem likely to be effective in achieving maintained and generalized responding. Maintenance may be facilitated through increasing similarity between training and assessment settings via either (a) employment of fading of reinforcement during training (cf. Jones & Kazdin, 1975; Koegel & Rincover, 1977; Stokes & Baer, 1977) or (b) training subjects to self-reward (cf. Jones & Evans, 1980; O'Leary & Dubey, 1979; Stokes & Baer, 1977) and (c) through use of isolated followed by simultaneous presentation of situations rather than simple isolated presentation (cf. Cuvo, Klevans, Borakove, Borakove, Van Landuyt, & Lutzker, 1980). The likelihood of generalization may also be increased through fading of reinforcement and self-reinforcement as well as through expansion of stimulus control (Kazdin, 1980; Stokes & Baer, 1977).

In regard to community relevance it is suggested, first, that children need to be able to adapt not only to everyday community situations but also to emergency situations such as residential fires. An equally important community concern is the need for more attention to moderately-to-severely mentally retarded individuals with regard to higher level adaptive skills (cf. Nutter & Reid, 1978), a problem highlighted by the growing trend toward normalization (Wolfensberger, 1972). A final community concern is the necessity for increasing attempts to validate

socially the improvements made by subjects. Such measures are likely to become of greater importance as adaptive skills interventions involve more complex behaviors.

Although a few investigators (e.g., Jones, 1980; Jones & Kazdin, 1980; Risley & Cuvo, 1980) have attempted to train children how to obtain emergency assistance, little has been done concerning the training of steps to be taken prior to the arrival of help. Jones, Kazdin and Haney (in press) documented the importance of emergency skills training and demonstrated the effectiveness of a behavioral package including modeling, behavioral rehearsal and self-delivery of reinforcement (following a verbal prompt from the trainer) in training fire exiting skills to "average" third graders in a simulated classroom setting with verbally given cues concerning the proximity of the fire. Social validation of the target behaviors and of improvement established the relevance of training to actual fire emergencies. A two-week postcheck demonstrated maintenance over that period of time. In a similar investigation, Matson (1980) examined both fire and medical emergencies. One major finding was that practice of actual behavior was needed to bring about changes in role playing behavior among moderately mentally retarded subjects in medical emergencies. Indeed, in vivo training may not only permit both frequent and immediate feedback in the natural setting but also maximize transfer of training (cf. Yeaton & Bailey, 1978).

The present investigation, as an extension of the Jones et al. (in press) study, was designed to contribute to the knowledge gained in that investigation in the following ways:

1. Programming of maintenance (via fading of reinforcement, self-reinforcement and isolated followed by simultaneous presentation of situations) for subjects who met certain requirements.

2. Programming of generalization (via fading of reinforcement, self-reinforcement and training in a different room) for subjects who reached designated criteria.

3. Assessment of all subjects with reference to maintenance and generalization (to a second bedroom).

4. Examination of the feasibility of in-home training and employment of sensory cues (auditory, visual and tactile).

5. Training of moderately-to-severely retarded children, using a simplified task analysis, and subsequent assessment of social validation of improvement.

Method

Overview

Acquisition and maintenance of correct fire exiting responses by mentally retarded children following behavioral training in fire emergency skills were examined through the employment of a multiple baseline design across subjects and two months of post-check assessments. All training and assessment took place within a bedroom and the hallways of the children's place of residence. Generalization to a second bedroom was tested through a number of probes during baseline, training and follow-up. Subjects were required to attain criterion levels of responding on each situation prior to presentation of the next situation. Subjects who responded appropriately to delayed and self-reinforcement received all components of maintenance training and two components of generalization training. Only subjects who reached criterion on the situations to be trained received the third component of generalization training (training in a third bedroom).

Subjects

One moderately and three severely mentally retarded children (two black, two white; two male, two female) residing on the second floor of a group home in the city of Pittsburgh served as subjects.[1] None of the children had physical limitations. The administrators of the group home had expressed concern over the children's ability to exit the house in the event of a fire emergency, and parental consent for subjects to participate was obtained. These subjects were 12½ to 16 years of age

(mean = 14.5), with IQ's ranging from approximately 25 to 43 (mean = 33). Two of the scores were obtained from the Stanford-Binet (form L-M), and two were estimates of functioning.

Setting and Apparatus

Training focused upon those skills needed to exit from the house at night when the children would be awakened from sleep. Thus, training took place in a bedroom and the hallways of the house.[2] Although it would be important for children to be able to respond correctly in their own bedrooms, own-room training was not feasible because of other activities taking place in the children's rooms. Consequently, each child was trained and assessed individually in a less frequently used bedroom in the home, and generalization was assessed through testing in children's own rooms at various points. Generalization was programmed for children who reached criterion on the situations to be trained.

To increase the similarity between the simulated situation and an actual fire, several special props were used. This equipment included a tape recording of the actual sound of the house's fire alarm, a heated pad (to be employed when the door was hot), a cool pad (to be employed when the door was to be cool), a large, door-size "calendar" on a sheet (to cover both the door and the heated/cool pad so that there would be no visual cues), a blow dryer (to blow in hot air), a picture of smoke and a picture of fire. No other modifications were made with reference to the room or the other parts of the house.

Social Validation of the Behaviors

The present study used an adapted form of the responses socially validated in a previous investigation (Jones et al., in press).[3] Additional social validation (described in a later section) was undertaken following training to ensure that safe exit was likely if children performed the trained responses.

Task Sequence and Definition

Correct responses to the four situations were identified, taught and assessed. These responses consisted of a total of 45 steps across the four situations (ranging from eight to 13 per situation). There were 20 different responses, some of which occurred in more than one situation. Major modifications over the earlier version (Jones et al., in press) included reduction in the number of decision points, elimination of behaviors that are less essential to safety and simplification of some of the responses (e.g., feeling the door and bracing the door). This modified version is presented in Figure 1. As illustrated, children awaken to the sound of the fire alarm and subsequently slide to the edge of the bed, slide out of the bed, get in a crawl position and crawl to the door. At this point, they decide whether the door is hot with smoke coming under it. If it is hot with smoke coming under it, they crawl to the window, open it and wait for help. This is the correct sequence for both instructional and assessment situation 1. The other situations are illustrated by the remainder of the figure.

Insert Figure 1 about here

Assessment

Training room probes. In order to examine generalization from reinforced to non-reinforced responding, from familiar to unfamiliar experimenter and from trained to untrained responses, an assessment session was held in the training room once per session. During these sessions, subjects were given neither reinforcement nor feedback for performance. In addition, children were tested individually by a person other than the trainer. This assessment consisted of random presentation of the test situations (see Table 1) following the sound of the house's fire alarm. One of eight undergraduate testers recorded behavior for each situation.[4]

One point was given for each correct response in sequence. Because missed responses led to a break in the sequence, correct responses following errors were not given credit. The situation totals were summed for a total score, and percentages were then calculated based on this total sequence score. Because any break in the sequence could prove fatal, this approach was considered to be more representative of actual skill in escaping safely during a fire emergency than simple summation of correct responses (which were recorded whether in sequence or not).

Generalization room probes. Although all components of generalization training were not administered unless subjects met certain criteria, each child received generalization assessment. On several occasions, once during baseline, once during training, once on the final day of training and during 13 of the 14 post-check assessment sessions, subjects were assessed in a second bedroom (their own). This assessment was conducted in exactly the same manner as the training room probes and employed the same apparatus.

Post-check assessment. Although maintenance was to be programmed only in those subjects who satisfied certain requirements, all children were assessed in this area. For six months after training, an assessment was conducted in the training room under the same conditions as the previous assessment and again in the same manner. No feedback or reinforcement was provided during this time period.

Reliability. Reliability checks were taken during 14 of the 76 baseline and acquisition assessment sessions and 22 of the 35 post-check assessment sessions, with a second rater simultaneously recording behavior from a position across the room from the primary observer. Interobserver agreement was calculated for occurrences of correct responses in sequence by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The mean reliability during the study (both the 14 acquisition assessment checks and the 22 post-check assessment checks) was 99% for correct responses in sequence (range = 90-100).

Modified Assessment Procedure. Because Subject 4 would not always respond during assessment (often she did not even move in response to instructions from various testers), she was assessed by the trainer beginning with session 35. This assessment session was conducted in precisely the same manner as the previously described assessment. Reliability was taken during eight of the 40 acquisition sessions of this measure and during 15 of the 17 post-check assessments to ensure that scoring was consistent with the assessment by the testers. The mean agreement across sessions was 98% for correct responses in sequence (range = 88-100%).

Acquisition Training

Training, which lasted an average of 20 minutes per session, included modeling, instruction, behavioral rehearsal, explicit corrective feedback, social reinforcement in the form of praise, hugs and pats on the back, external tangible reinforcement and self-reinforcement. During the initial training session, subjects were told that they would be learning what to do in the event of a fire, and the reinforcement contingencies were spelled out. Subjects were then taught the responses in the order presented in Table 1. Beginning with session 2, each session began with a brief verbal review and a behavioral rehearsal of all previous lessons. If subjects responded correctly to all queries and fire emergency situations, they received training beginning where they had ended the previous session. Subjects proceeded as far as possible (within limits of time and attention span) through the sequence of lessons (in Table 1) during any given session. Once children reached criterion on all situations to be trained, each session consisted of the verbal and behavioral review only. Children were required to respond correctly to each situation on one occasion prior to termination of these review sessions. A brief verbal review and explanation of withholding of feedback and reinforcement during testing ended all sessions.

Insert Table 1 about here

Each lesson consisted of (a) an instructional period, (b) a practice period and (c) an evaluation period. During the instructional period (a), subjects were given verbal directions as the behavior was modeled. Practice (b) consisted of practice trials on the new behavior with feedback and social reinforcement from the trainer for each step. For example, practice during step 1 of the training sequence proceeded in the following fashion:

> T played the sound of the actual fire alarm. S slid to the edge of the bed. T said, "Good! You slide to the edge of the bed." S slid out. T said, "Good! You slide out." S got in a crawl position. T patted S on the back and said, "Good! You crawl."

If subjects erred on any portion, they received feedback and modeling at that point: e.g., T said, "No, you crawl--like a puppy," and modeled the correct behavior if the child had sat down upon getting out of bed. Children continued to practice until they performed the entire sequence correctly. Tangible reinforcement was received (or taken, depending upon where the child was with respect to maintenance training) at the completion of sequences. During evaluation (c), feedback and social reinforcement were withheld until the end of the sequence, unless an error occurred prior to this point. After the sequence for step 1, for example, T would say, "Good! You slid out of bed and crawled." If subjects made a mistake prior to this, feedback and modeling were given at the point of the error. Tangible reinforcers were received (or taken) at the completion of sequences.

In both practice and evaluation, increasing amounts of assistance were given as needed. Initially, the child had the opportunity to perform without assistance (after hearing the fire alarm). If the child hesitated for longer than 10 seconds, verbal prompting was given (e.g., "Where do you go?"). If a child made an error, the verbal feedback plus modeling procedure described earlier was given. If children made a mistake following feedback and modeling, they were given intensive practice on the portion of the response sequence that was causing difficulty until it was performed

correctly three or four (depending on the task) consecutive times. This practice was conducted with continuous feedback and social reinforcement and a light touch (if necessary). Manual guidance, consisting of a firm touch until the child gained momentum in the right direction, was necessary only for rolling.

Criterion for completion of lessons varied, depending on the task. For all lessons up until completion of training on situation 1, three consecutive correct responses during evaluation (c) were required for criterion. For situations 2, 3 and 4, criterion was one correct response during evaluation. Following each of situations 2, 3 and 4, the subsequent "lesson" was mixed presentation of the new and previous situations. Only phase c, evaluation, was administered during these "lessons," with a criterion of three consecutive correct responses.

Remediation, consisting of the intensive practice described above, was given if children erred on a previously trained situation during (a) training room probes (remediation given during next session) or (b) review sessions at the beginning of sessions (remediation given during same session).

Maintenance Training

Because of both the importance of exiting safely during a fire emergency and the infrequency of actual emergencies, it seemed important to demonstrate that not only acquisition but also maintenance of responding could be trained. Three aspects of the training procedure were manipulated to facilitate maintenance: (a) the mode of presentation (employment of isolated followed by simultaneous presentation of situations), (b) the schedule of reinforcement (use of fading) and (c) the mode of reinforcement (alteration from external to self-reinforcement). Although all of these strategies were carried out concurrently with acquisition training, the latter two, fading of reinforcement and alteration to self-reinforcement, were engaged only if subjects demonstrated continuance of appropriate responding following their introduction. This was done because unreadiness for either fading of reinforcement or self-reinforcement could interfere with acquisition.

With regard to presentation, all subjects received training on individual situations followed by simultaneous presentation of all previously learned situations. The sequence is detailed in Table 1.

Reinforcement was faded both within and across lessons, with subjects remaining in a given phase or lesson until attainment of criterion. Within each lesson, both feedback and social reinforcement were faded from continuous during practice (phase b) to intermittent during evaluation (phase c). Across lessons, reinforcement was faded through requiring increasingly longer sequences of responses prior to delivery of reinforcers. That is, reinforcement was initially administered upon subject completion of a short sequence of correct responses (in lesson 1 of the training sequence): (a) sliding to the edge of the bed, (b) sliding out and (c) getting in a crawl position. After criterion was reached on this chain of responses, two other steps were required in addition to these steps prior to the trainer's delivery of reinforcers (in lesson 2). Completion of lesson 4 required that subjects perform the entire chain of eight responses necessary for correct responding to situation 1 (i.e., steps a, b, c, d, e through h) prior to trainer delivery of reinforcers. While subjects were attempting to attain criterion on the second situation, performance of the entire chain of responses to this situation was required prior to trainer delivery of reinforcers.

After criterion was reached on the second situation, subjects began training on how to self-reinforce at the completion of the chain of responses necessary for correct responding to either one of the previously trained situations or to the third situation. When subjects reached criterion on all four situations, they were to self-reinforce after completion of correct responding to the entire set of four situations. Thus, self-reinforcement was taught through fading of external influence. As described previously, the teacher initially served as a model by demonstrating the quality and quantity of behavior to be reinforced (criterion-setting) and administration of reinforcers. When the child began training to self-reinforce, a verbal prompt

was given both prior to (e.g., "You may take some candy when you are done") and at the completion of (e.g., "You may take some candy now") the task so that children knew when the trainer thought they should self-administer reinforcers. Subjects were considered to respond appropriately during this initial phase of self-reinforcement if they evidenced attainment of the stringent standards predictive of long-term maintenance (i.e., reinforced only following completion of the sequence) (cf. Jones & Evans, 1980). For these children, verbal prompts concerning criterion setting were eventually faded and provided only at the outset of the task. Finally, all prompting was eliminated, and the reinforcers were simply placed in sight of children, to be delivered at their discretion. For those subjects not able to adhere to stringent self-reinforcement standards, there was a return to the previous mode of reinforcement (i.e., external reinforcement was given at the end of responding to each situation). The child continued with this mode of reinforcement until the stringent standards necessary for self-reinforcement were demonstrated.

Generalization Training

Because some children may not always sleep in the same bedroom, a secondary concern was programming of generalization. Generalization training consisted of three components: fading of reinforcement, self-reinforcement and training in a third room (apart from the training and generalization assessment rooms). The first two components were administered concurrently with acquisition and maintenance training. (In fact, these components were employed to facilitate not only generalization but also maintenance.) However, these two components alone did not appear likely to result in adequate generalization without training in a third room, particularly in view of the children's deficiencies in language/cognitive skills. Therefore, children who reached criterion on the situations to be trained received training in a third room during five sessions held at randomly chosen intervals (because of the occurrence of other activities in this room) throughout the remainder of the sessions. These training

sessions were conducted in the same manner as the review sessions described under training, with subjects being required to perform each situation correctly once prior to termination of the session. Because of the importance of acquisition and maintenance, training was not to take place in a third room until subject attainment of criterion on all target situations. This measure was taken to avoid both potential subject confusion and subsequent deterioration of the rate and magnitude of acquisition and maintenance.

Social Validation of Outcome

In order to validate socially the effectiveness of this simplified training procedure, 18 firefighters (from local fire departments) were asked to evaluate subject performance levels associated with baseline and training. The questionnaire was adapted from Jones et al. (in press).[6]

For each of the four situations, firefighters were asked to rate the likelihood of the two types of responses (baseline and training) leading to the following consequences: (a) reaching safety, (b) getting burned severely, (c) being overcome by smoke, (d) being burned to death and (e) panicking. The order of the two types of responses was counterbalanced, and firefighters were asked to rate the likelihood of each of the five consequences on a five-point scale (from 1 = very likely to 5 = very unlikely).

Results

Subject Performance

The impact of training upon subject performance of correct responses is illustrated in Figure 2. Prior to training, subjects emitted relatively few correct responses (mean = 0.94%). During training, correct responding rose to 72.18% across all subjects.[7] During post-check assessments over a period of two months, subjects maintained their high levels of responding (mean = 79.94%). Individual performance was generally consistent with group performance. That is, all subjects relatively consistently achieved 100% scores on the situations for which they received training.

Subject 1 was able to master all four situations, and this is depicted by a series of uninterrupted 100% scores beginning with session 32. Similarly, Subject 3 was able to master all three of the situations on which he was trained and assessed, as is illustrated by a series of 100% and near-100% scores beginning with session 44. However, the consistency with which Subjects 2 and 4 achieved 100% scores on two of the situations (60% of the total responses for the three situations) is not demonstrated on the graph because these subjects were assessed but not trained to criterion on the third situation (because of incurred difficulty resulting from reactivity of baseline assessment on this situation).[8] Hence, 83% was typically the threshold of their correct responses.

Insert Figure 2 about here

The changes in performance resulting from the introduction of training generally met the criteria for the multiple baseline design. Correct performance increased for each subject when and only when training was introduced.[9] Only Subject 4 deviated from the general pattern of continued high levels of correct responding. However, the assessment given by the trainer resulted in a return to high levels of performance.

High levels of correct responding were observed at maintenance checks given over a period of two months after training had been terminated. Again, these results are consistent with individual performance. Subjects 1, 2 and 4 continued to perform at the levels they had achieved during the latter part of training. For Subjects 1 and 4, scores were 100% and 83% respectively. Subject 2 at first maintained the variable responding that characterized his performance during the latter portion of training with scores ranging from 40% to 80% and then maintained performance at levels approximating 75%. Subject 3 (the only child who did not receive the self-reinforcement component of maintenance training) was the only child who showed a decline in performance,

decreasing to 67% after one month and 53% after two months. Maintenance checks at one-month intervals for the next four months revealed a continuance of these trends. Subjects 1 and 4 remained at 100% and 83%, respectively. Subject 2 continued to score high, with some variability (scores of 83%, 73% and 70% at the 4-, 5- and 6- month checks, respectively). Subject 3 continued to respond at moderate levels, scoring 63%, 57% and 57% at the 3-, 5- and 6-month checks, respectively.

During baseline and training, as well as immediately following the last session of training, and at 13 post-check assessments, a generalization probe was taken. As depicted in Figure 2, for Subjects 1 (who received all components of this training) and 3 (who received fading of reinforcement and training in a third room but generalized once prior to the latter type of training), these results approximated those of assessment in the training room. For Subjects 2 and 4 (who did not receive the critical training in a third room), training resulted in an increase over baseline but not of the same magnitude as that of Subjects 1 and 3.

Interestingly, maintenance in the generalization room followed much the same pattern as that in the training room. Subjects 1, 2 and 4 maintained at the level (or at a higher level than) they had attained at the assessment immediately following training. Subjects 3's performance declined in both rooms at the same rate.

Social Validation of Outcome

Chi square analyses were performed on the 18 firefighters' ratings for each of the five consequences for each of the four situations. In all four situations (see Table 2), firefighters indicated that children were much more likely to reach safety following training and much less likely to be burned severely, to be overcome by smoke, to be burned to death and to panic after training.[10] In only one situation was any difference in consequences less than significant (at $p < .01$) and in this case the difference approached significance ($p < .10$). These results suggest that levels of performance associated with training were judged by firefighters to be less likely to result in panic, injury and loss of life during fire situations than levels of performance associated with baseline.

Discussion

In support of the findings of Jones et al. (in press), the results indicated

that a multifaceted behavioral training package was effective in training children what to do in several simulated emergency fire situations in the home.[11] Moreover, the maintenance procedure was effective in maintaining these responses for a six-month period of time, and the investigation extended the findings to home (from classroom) settings, to sensory (from verbal) stimuli and to moderately-to-severely mentally retarded (from "average" and "low-average") children. Finally, generalization of responding varied in relation to the amount of training received. The effectiveness of training was illustrated primarily through both a multiple baseline design across subjects and ongoing maintenance probes. Generalization probes provided a secondary focus of interest. Both specific responses and the effectiveness of the modified training procedure were socially validated by ratings of firefighters.

This study has several distinguishing features. First and foremost, there was an effort to assess not only acquisition but also maintenance of responding. Maintenance of responding was programmed in three of the children through isolated followed by simultaneous presentation, through fading of reinforcement and through self-delivery of reinforcement. The fourth child required an extended period of external reinforcement and was therefore not exposed to all components of maintenance training. After six months of periodic post-checks, the three subjects who received all components of this training were responding at levels approximating their performance during acquisition assessment. The fourth (Subject 3), who had not received the self-reinforcement component, showed a moderate decline in performance. These results emphasize the importance of maintenance training, particularly for skills that are used infrequently. It is suggested that six-month maintenance, during which corrective feedback and reinforcement are not provided, is more than sufficient in light of the monthly practice advocated by fire officials.

A second important feature was the effort to validate socially subjects' improvements. The results of this validation overwhelmingly indicated that, in the opinion of the firefighters questioned, children were less likely to suffer personal harm after training.

A third feature that merits attention was the employment of techniques to increase the similarity between the training setting and an actual fire. Subjects were taught the precise motor behaviors necessary to reach safety in the event of a fire, were taught in the actual home and were presented with cues that simulated the sensory cues of an actual fire. In addition, children were required to perform for a number of experimenters to ensure that they could respond regardless of who (if anyone) happened to be present when a real fire occurred. Although the success of these endeavors in changing behavior during actual fire emergencies was not assessed for obvious ethical reasons, their employment did much to improve the resemblance between the training setting and an actual fire emergency.

A fourth point is that generalization, although not of primary interest, was assessed in all subjects. Generalization of responding (to a second room) was programmed through fading of reinforcement, self-reinforcement and training in a third room. Only those subjects (1 and 3) who received the critical training in the third room ever scored at 100%. Subjects 2 and 4, who completed only the delayed and self-reinforcement components of generalization training, scored minimally but higher than baseline (30%). Subject 3's performance is somewhat difficult to interpret in that he did not receive all generalization components (but only delayed reinforcement) at the time of his first 100% performance. Inasmuch as it was discovered that one subject generalized subsequent to all components of generalization training, one subject generalized with only fading of reinforcement and two subjects generalized minimally in the absence of training in the third room, it is suggested that some combination of subject, stimulus and training variables may account for effectiveness in this area. Consequently, it appears that training of this skill (including the fading of reinforcement and self-reinforcement) should be followed by generalization assessment, with generalization training in a third room given only if necessary.

Finally, it seems that the amount of time necessary to train subjects was small in comparison to the value of the skill learned. Subjects required between 10 and 25

($\bar{X}$ = 17) sessions to reach criterion on the target situations. These figures include means of 28.69 (range = 7.75 to 84.5) minutes and 6.5 (range = 1.75 to 17.75) trials per lesson.

Two major limitations require mention. First, because of other activities occurring in their bedrooms, these subjects did not receive the benefit of training in their own rooms during the course of the study. However, children were trained in an actual bedroom in their own home, leading to two important findings: (a) in vivo training of this skill was successful and (b) programming of generalization may overcome obstacles to own-room training (those trained in a third room did generalize). Notwithstanding these findings, the importance of either own-room training or programming and assessment of generalization should be emphasized.

A related limitation was the lack of assessment in the absence of an adult. Although subjects' safety as well as experimenter availability necessitated adult presence in the current investigation, future research may resolve some of the issues that stem from such practices. Perhaps testing of only situations not requiring heated devices, placement of nonremovable screens in windows and experimenters hidden outside all exits could eliminate some of these problems.

In addition to these limitations, several areas could not be evaluated by the present effort and need to be examined in future research undertakings. Such endeavors might assess the effects of cognitive variables (e.g., children's attitudes toward fire emergencies) and procedural variations as well as the feasibility of teaching staff members, parents and siblings to conduct training.

While the success of the present investigation cannot be entirely known in the absence of an actual fire, important steps were made toward increasing the generalizability of the target responses to the setting and time where they would be needed. Subjects in the present study not only demonstrated their ability to perform the correct emergency responses in the actual home setting with simulated sensory cues but also demonstrated retention of this learning six months following removal of all

contingencies and practice. In addition, intervention directed toward emergency responding and moderately-to-severely mentally retarded subjects, with social validation of improvement, served to address several issues relevant to the community.

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Footnotes

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[1]Prior to participation, subjects were required to demonstrate ability in several areas: (a) ability to follow simple commands to perform motor tasks after viewing a model and ability to perform all of the motor tasks in each behavioral sequence, (b) ability to respond to simple questions (e.g., "Where is the door?" and "Point to the window") and (c) ability to recognize a fire as demonstrated through ability to "point to the fire" (from a series of three randomly placed pictures).

[2]It should be pointed out that the house had spacious rooms (21' x 14' training room) and hallways (45' plus 20 steps with three landings). In spite of the distance, all subjects were required to perform all responses because of the importance of increasing the similarity between the target responses and the behaviors to be performed in an actual fire emergency.

[3]Nine sequences of responses were developed and trained in the previous study (Jones et al., in press). However, only the four situations where unassisted escape through the window was impossible were included in the present inves-

tigation because these children lived on the second floor. Within the four chosen situations, the two most essential responses seemed to be going to the window when escape was blocked and getting out of the house. Although "hot air," fire-in-path" and "hot door" situations all involved going to the window, "hot door" was the least complex and seemed most likely to be used in a fire. Consequently, "hot door" and "nothing-blocking-path" were the first two situations to be trained. Situation 4 ("fire-in-path") appeared more useful than situation 2 ("hot air") (the door was likely to be hot if hot air would rush in) and was to be taught to all subjects following training of the first two situations.

[4]The four situations and operational definitions for the correct responses to each are available on request from the second author.

[5]Only Subject 1 was required to perform all 45 steps. The difficulty of the second situation, coupled with the performance of the last three subjects on the simpler tasks of the preliminary assessment and staff reports of ability, suggested that further simplification of the required task would maximize rapid, nonfrustrated learning by Subjects 2, 3 and 4. (However, in the interests of safety, Subject 1 was taught all four situations, and her total data are reported for more complete information.) As a result of this alteration in the initial plan, there were 30 steps, with 20 different responses (three situatinns) for Subjects 2, 3 and 4.

[6]First, a mean level of performance was obtained for the first three sessions of baseline and the last three sessions of training. For situation 2, only Subject 1's scores were used (because she was the only child trained on this difficult sitation). For situation 4, only scores for Subjects 1 and 3 were used (because Subjects 2 and 4 were not taught these situations to criterion). For training, the mean levels

of performance were then translated into the specific correct behaviors represented by the calculated numbers. For baseline, a general account of responses was used to better portray subjects' varied behaviors (e.g., continuing to lie in bed, sitting up, getting out of bed and running out of the room to point at the fire alarm box out in the hallway) during this portion of assessment.

[7] Initially, behaviors such as continuing to lie in bed, stopping midway through the sequence (e.g., after feeling door, after seeing fire or after coming back to the room following discovery of a fire in their path) and forgetting to say they would wait for help, accounted for errors. Less often, major mistakes such as forgetting to feel the door, opening a hot door, walking and crawling to window when door was cool were made. These behaviors declined in frequency as training continued.

[8] This phenomenon is discussed in more detail by Horner and Baer (1978). Briefly, it refers to a tendency for subjects to continue to respond after initiation of treatment as they had during baseline when baseline is continuous and the occasion for responding is set by the experimenter.

[9] There is a definite tendency for subjects to continue baseline responding for several sessions after the introduction of training. Again, this lag in responding suggests that baseline was reactive (cf. Horner & Baer, 1978).

[10] The following chi square values were obtained (with values representing situations 1, 2, 3 and 4 respectively): (a) for reaching safety: $\chi^2(1) = 11.78$, $p < .01$; $\chi^2(1) = 10.43$, $p < .01$; $\chi^2(1) = 14.60$, $p < .001$; and $\chi^2(1) = 22.10$, $p < .001$, respectively; (b) for being burned severely: $\chi^2(1) = 19.17$, $p < .001$; $\chi^2(1) = 12.25$, $p < .001$; $\chi^2(1) = 5.83$, $p < .02$; and $\chi^2(1) = 9.9$, $p < .01$, respectively; (c) for being overcome by smoke: $\chi^2(1) = 15.56$, $p < .001$; $\chi^2(1) = 7.02$, $p < .01$; $\chi^2(1) = 7.72$, $p < .01$; and $\chi^2(1) = 25.60$, $p < .001$, respectively; (d) for being burned to death: $\chi^2(1) = 15.36$, $p < .001$; $\chi^2(1) = 8.73$, $p < .01$; $\chi^2(1) = 3.60$, $p < .10$, nonsignificant; and $\chi^2(1) = 11.80$, $p < .001$, respectively and (e) for panicking: $\chi^2(1) = 11.20$, $p < .001$; $\chi^2(1) = 5.55$, $p < .02$; $\chi^2(1) = 7.00$, $p < .01$; and $\chi^2(1) = 13.40$, $p < .001$, respectively.

[11]It should be noted that training was terminated at different points for different subjects. While 100% correctness is certainly a desirable goal, some consideration must be given to the abilities of the individual subject. Consequently, one subject received training on four situations, and the others were trained on three. In addition, a major obstacle to training was the reactivity of long baseline assessment on situation 4 for Subjects 2 and 4. Because training on this situation would have taken longer than the time period of the current investigation for these two subjects, it was discontinued. Thus, the effort was directed toward attaining the maximum performance capability for each subject, given the limitations imposed by the investigation. Inasmuch as continuous baseline assessment revealed stable, near-zero baselines and lack of response generalization in both this and the previous investigation (Jones et al., in press), it is suggested that use of a multi-probe strategy of assessment would reduce this problem in the future.

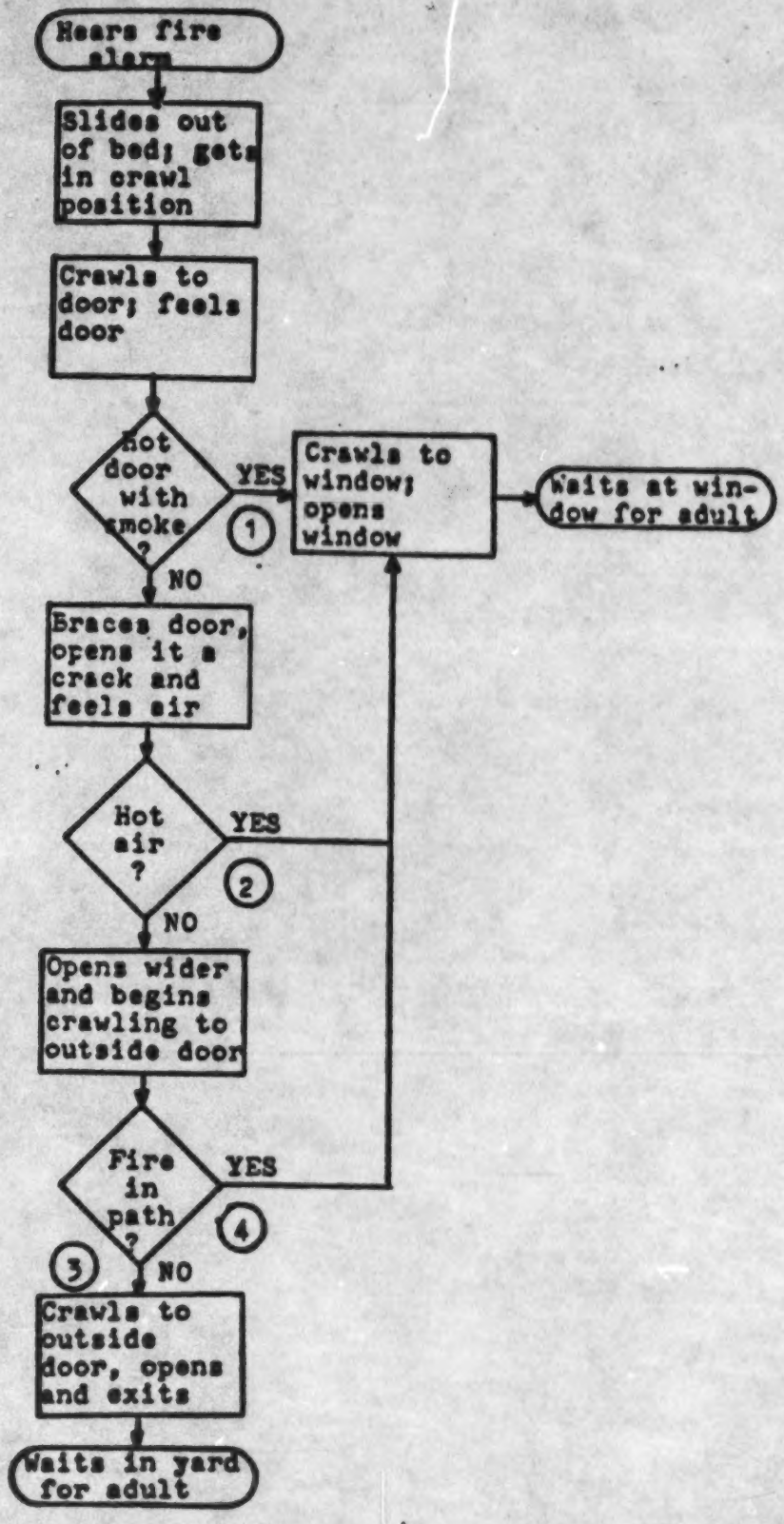
Table 2

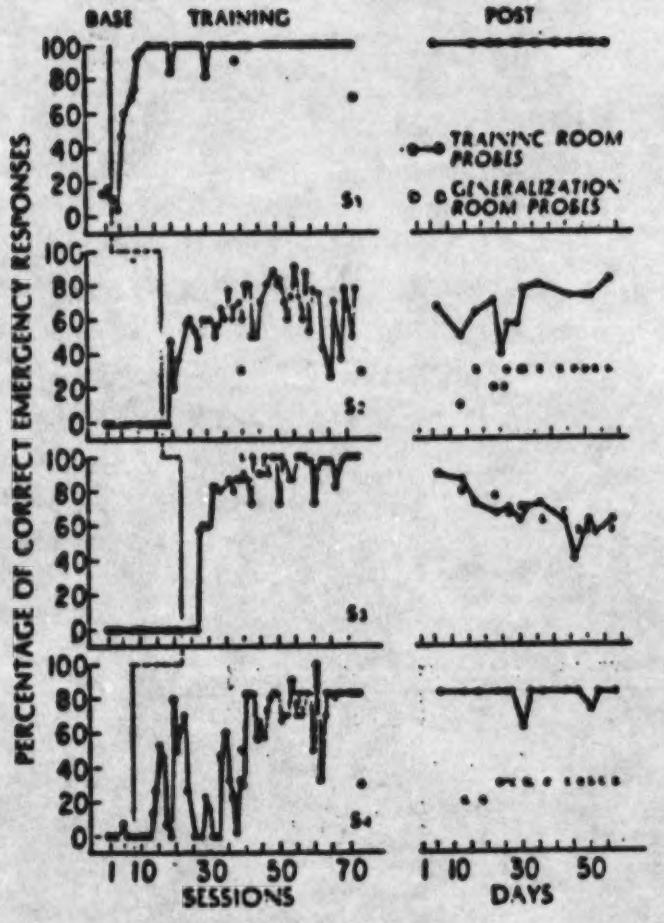
Training Sequence

1. Sliding to the edge of the bed, sliding out and getting in a crawl position.
2. Step 1 plus crawling to the door and feeling the door.
3. Step 2 plus crawling to the window when the door is hot and there is smoke at the bottom of the door.
4. Step 3 plus opening the window and saying that they would wait for help (situation 1).
5. Step 2 plus feeling the air and crawling to the window when the air is hot (situation 2).
6. Simultaneous presentation of situations 1 and 2.
7. Step 2 plus feeling the air, crawling (and sliding down the steps) to the outside door when the door and air are cool, opening the door and saying they would wait for help (situation 3).
8. Simultaneous presentation of situations 1, 2 and 3.
9. Step 2 plus feeling the air, crawling until seeing a fire, crawling back to the room, closing the door, crawling to the window, opening the window and saying they would wait for help when there is fire blocking the way (situation 4).
10. Simultaneous presentation of situations 1, 2, 3 and 4.

Figure 1 A flow chart analysis of emergency escape skills from the second floor of the home at night. Ovals represent termination points, rectangles represent responses and diamonds represent decision points.

Figure 2 Correct Emergency Responses Performed in Sequence. Baseline--no intervention implemented, testing administered each session. Training--implementation of training program, assessment again given each session (ending with session 73). Post-check--intervention withdrawn, assessment administered periodically beginning seven days after training and ending 58 days after training. Generalization--probes taken in a second bedroom at various points (session 4, sessions 39-40, session 73) throughout baseline and training and during 13 post-check assessments. It should be noted that the second subject to begin training (S_4) has been placed last to indicate that her assessment was administered by the trainer rather than one of the eight testers (beginning with session 35).


Hears fire alarm
Slides out of bed; gets in crawl position
Crawls to door; feels door
Hot door with smoke ?
YES
1
Crawls to window; opens window
Waits at window for adult
NO
Braces door, opens it a crack and feels air
Hot air ?
YES
2
NO
Opens wider and begins crawling to outside door
Fire in path ?
YES
4
3
NO
Crawls to outside door, opens and exits
Waits in yard for adult


BASE
TRAINING
POST
PERCENTAGE OF CORRECT EMERGENCY RESPONSES
100
80
60
40
20
0
S1
S2
S3
S4
TRAINING ROOM PROBES
GENERALIZATION ROOM PROBES
1 10 30 50 70
SESSIONS
1 10 30 50
DAYS